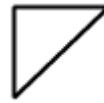


MARS Task: Patchwork

Katerina makes patchwork cushions.

She uses right triangles



and squares.



She uses triangles along the edges of each cushion, the rest is made from squares. The backs of the cushions are made of plain material, not patchwork.

Here are the first five sizes of patchwork cushions.

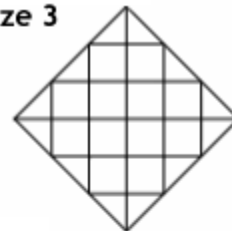
Size 1



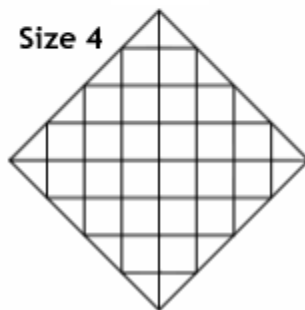
Size 2



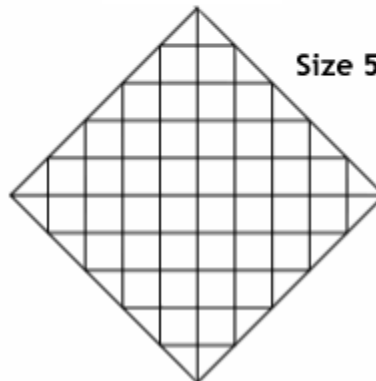
Size 3



Size 4



Size 5



Katerina makes cushions in lots of other different sizes.

She begins to figure out how many triangles and squares she needs for each size.

For size 1, she needs 4 triangles and 0 squares.

For size 2, she needs 8 triangles and 4 squares.

1. Complete this table to show how many triangles and squares she needs for each of these five sizes:

Size (n)	Number of triangles (t)	Number of squares (s)
1		
2		
3		
4		
5		

2. Find a rule, or a formula, that will help Katerina to figure out the number of triangles that she needs for cushions of different sizes. Explain why your rule works.
3. Use the number patterns in the table to find a rule, or a formula, that will help Katerina to figure out the number of squares that she needs for cushions of different sizes. Explain why your rule works.
4. Katerina has a cushion with 180 squares on it.
How many triangles are on this cushion? Show how you figured it out.

Scoring rubric

The following scoring rubric was developed specifically for this task and can be used to evaluate your students' work.

Patchwork	Points possible	Total section points possible																		
<p>1. Correctly completes the table: Allow 1 point for each of size 3,4 and 5 triangles and squares.</p> <table border="1"> <thead> <tr> <th>Size (n)</th><th>Number of triangles (t)</th><th>Number of squares (s)</th></tr> </thead> <tbody> <tr> <td>1</td><td>4</td><td>0</td></tr> <tr> <td>2</td><td>8</td><td>4</td></tr> <tr> <td>3</td><td>12</td><td>12</td></tr> <tr> <td>4</td><td>16</td><td>24</td></tr> <tr> <td>5</td><td>20</td><td>40</td></tr> </tbody> </table>	Size (n)	Number of triangles (t)	Number of squares (s)	1	4	0	2	8	4	3	12	12	4	16	24	5	20	40	3x1	3
Size (n)	Number of triangles (t)	Number of squares (s)																		
1	4	0																		
2	8	4																		
3	12	12																		
4	16	24																		
5	20	40																		
<p>2. Rules: An algebraic formula, such as: $t = 4n$. Accept $4n$ or The number of triangles is four times the size of the cushion. or A recursive formula e.g. $t = n + 4$, with variables clearly defined</p> <p>Explanations: Each cushion has four edges: each edge has the same number of triangles as the size. or From the table, as the size of the cushion increases by 1's, the number of triangles increases by 4's. or Explains recursively without reference to the cushion.</p>	<p>2</p> <p>or 2</p> <p>or (1)</p> <p>2</p> <p>or (1)</p> <p>or (1)</p>	4																		
<p>3. Rules: An algebraic formula, such as: $s = 2n(n-1)$ or equivalent or A recursive verbal rule, such as: The number of squares increases by 4, then 8, then 12, then 16...: increasing multiples of 4. or The number of squares + the number of triangles for any size is equal to the number of squares for the next size, e.g.: $16 + 24 = 40$ or The number of squares equals the size \times increasing even numbers</p> <p>Explanations relating to the cushion design, such as the following. Algebraic formula: Each cushion has four sections: if we put two sections together, we get two rectangles, size n by $(n-1)$. or Recursive rule: Each triangle of one size becomes a square in the next size.</p>	<p>4</p> <p>or (2)</p> <p>or (2)</p> <p>or (2)</p> <p>2</p> <p>or 2</p> <p>or 2</p>	6																		
4. The number of triangles is 40 with correct supporting evidence.	2	2																		
Total points possible for task		15																		